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ROLLED TAPE AND PRODUCTION THEREOF

*[Kasane makitsuke teipu oyobi sono seizoh houhoh]*

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*[There are no amendments to this patent.]*

## **Specification**

### **Detailed description of the invention**

In the present invention, a solution containing a crosslinkable photosensitizer or a crosslinkable photosensitizer and a photoactive crosslinking agent and a vinyl-based polymer compound is dispersed on the edge face of a variety of tapes having adhesion at the edge face such as pressure-sensitive adhesive tapes and self-stick tapes using a method such as coating or spraying, and an activating beam is applied to the above-mentioned coated surface and crosslinking is carried out for the oozed-out pressure-sensitive adhesive itself or the pressure-sensitive adhesive and the above-mentioned vinyl-based polymer compound added to form a cured layer, and to prevent oozing of adhesive and "telescoping" of the edge face of the pressure-sensitive adhesive tape or self-stick tape.

Tapes such as pressure-sensitive adhesive tapes or self-stick tapes are commonly produced by coating a pressure-sensitive adhesive on a film substrate made of a material such as polyvinyl chloride, polyethylene, rubber, paper, cellophane, polyester, or a fluoro resin, followed by drying and subsequently the tape is wound on a cylindrical paper core, etc. and in this case, tension is applied at the time of winding, and in general, the film or sheet is wound in a stretched state.

Thus, pressure-sensitive adhesive tapes produced as described above experience a latent shrinkage force, and the force is applied from the outside wrap toward the center core, and, as a result, the pressure-sensitive adhesive on the pressure-sensitive adhesive tape is compressed and pressed outward toward the edges of the rolled tape and oozing occurs. As a result, dust adheres

during storage and use, or blocking of rolls of tape occurs when rolls are stacked on top of each other [edge to edge].

Furthermore, the over-wrapped portion of the above-mentioned tapes at the edge face forms a telescope-like shape due to the above-mentioned shrinkage force at the edge face, resulting in a reduction in product value.

In an attempt to eliminate the above-mentioned oozing of adhesive, a method wherein a coating solution such as a varnish or lacquer is coated onto the edge face has been proposed, but when the method is used, drying of the coating solution requires a long time, and uneven coating poses a problem; furthermore, the oozing of adhesive that appears to be in-control right after coating appears again after storage at high temperature for an extended period of time as a result of migration of the adhesive to the edge face, and subsequent lifting of the coated layer, and when the tape is left standing for a continuing period, oozing of adhesive takes place and telescoping results.

As a different method, a method wherein a paper or plastic film is applied to the edge face so as to protect the edge face, etc. has been proposed. However, in this method, application of the film to each roll of tape is required, and the process requires additional labor, is inconvenient, and takes time; thus, additional cost is added to each unit of tape; furthermore, the above-mentioned film falls off at the time of use.

And furthermore, as a means to prevent telescoping, many methods, for example, a method wherein the tape is supported by a metal reel, a core is inserted inside the cylindrical paper core, etc. so as to absorb the shrinkage force, have been proposed.

However, all of the above-mentioned conventional methods require additional processes and extra materials, as well as added cost; furthermore, when the tape roll is left standing at a high temperature, the above-mentioned oozing and telescoping continue to occur. Furthermore, conventional treatments for telescoping are complicated, and due to the additional equipment required, a higher cost cannot be avoided.

The present invention is to block "oozing" of the adhesive of pressure-sensitive adhesive tape or self-stick tape having adhesion at the edge face, and the purpose of the present invention is to solve the problems of the prior art. Furthermore, the present invention is to block "telescoping" and to improve applicability of the present invention.

The present invention pertains to a method consisting of coating the adhesive edge face of a tape such as a pressure-sensitive adhesive tape (includes double-coated pressure-sensitive adhesive tape) produced by coating a film or sheet substrate made of a material such as polyvinyl chloride, polyethylene, polypropylene, polyester, rubber, paper, cellophane or a fluoro resin having a pressure-sensitive adhesive such as a rubber-based pressure-sensitive adhesive and acrylic base polymer, or a self-stick tape made of a material such as butyl rubber, neoprene rubber, polyethylene or silicone rubber with a solution containing a crosslinkable photosensitizer, or a crosslinkable photosensitizer and a photoactive crosslinking agent and a vinyl-based polymer and exposing the above-mentioned coated surface to an activating beam and crosslinking the pressure-sensitive adhesive layer at the edge face of the tape or between the pressure-sensitive adhesive and the coated polymer so as to form a cured layer.

The above-mentioned photoactive crosslinking agent in this case means a material capable of eliminating active hydrogens in the polymer upon being exposed to an activating beam or a material capable of transmitting excitation energy from the excitation state to the active crosslinking agent and for example, benzophenone, 4-hydroxy benzophenone, 2-chloro anthraquinone, 2-methyl anthraquinone, benzoyl anthraquinone, anthranone, 1,4-naphthoquinone, 9,10-anthraquinone, 1,2-benzo anthraquinone, other aromatic ketones, aromatic aldehydes, aromatic carboxylic acids, and furthermore, organic compounds containing photosensitive halogen atoms can be mentioned.

The amount of the above-mentioned component used is in the range of 0.01~20 parts by weight for 100 parts by weight of the solvent, and in the range of 0.1~5 parts by weight is especially desirable. When the amount used is 0.01 parts by weight or below, the crosslinking rate based on application of light is reduced. On the other hand, when the amount of the component exceeds 20 parts by weight, the cost is increased; furthermore, recoupling among sensitizers is likely to take place; furthermore, light transmittance is blocked, resulting in a reduction in the curing rate.

The above-mentioned photoactive crosslinking agent is a material activated upon application of excitation energy from the activating beam or sensitizer and initiates crosslinking of the vinyl-based polymer or copolymer included in the tape material or the pressure-sensitive adhesive or dispersion, and as a result of the increase in crosslinking rate based on the above-mentioned crosslinking agent, light application time is reduced. For the above-mentioned photoactive crosslinking agent, N,N'-methylene bisacryl amide, ethylene glycol dimethacrylate, polyethylene glycol dimethacrylate, 5-acryl amino-N-acryl caproamide, etc. can be mentioned.

The amount of the above-mentioned component used is in a range of 1~50 parts by weight, preferably 2~20 parts by weight, for 100 parts by weight of the solvent. When an excess amount is used, the crosslinking density becomes too high and flexibility is reduced as a result of excessive three-dimensional linking and cracking can result; on the other hand, when the amount used is insufficient, the target effect cannot be expected.

The above-mentioned vinyl-based polymer compound is added when the crosslinking rate of the pressure-sensitive adhesive tape or self-stick tape is slow, crosslinking is less likely to be achieved due to rupturing, or a high edge face strength is required based on the type of tape used, etc., and when crosslinking is performed for the pressure-sensitive adhesive tape or self-stick tape and the above-mentioned vinyl-based polymer, an increase in the crosslinking speed and an increase in the strength of the edge face can be achieved. For examples of the above-mentioned vinyl-based polymer, polyethylene, ethylene-vinyl acetate copolymer, acrylic acid-acrylate copolymer, etc. can be mentioned. The amount of the above-mentioned compound used is in the range of 1~30 parts by weight for 100 parts by weight of the solvent. When the amount used exceeds 30 parts by weight, the increase in the coating layer blocks the transmittance of light, the mutual crosslinking of the vinyl-based polymer added is promoted, and the degree of crosslinking of the pressure-sensitive adhesive tape or self-stick tape is not adequate.

For the solvent used in this case, an organic solvent capable of dissolving the above-mentioned sensitizer, photoactive crosslinking agent and vinyl-based polymer, for example, toluene, tetrahydrofuran, methyl ethyl ketone, acetone, etc. can be mentioned.

For the source of the activating beam, a xenon lamp, low-pressure mercury lamp, high-pressure mercury lamp, super-high pressure mercury lamp, sunlight, carbon arc lamp, etc. can be

mentioned, and those having a wavelength in a range of 1500  $\Delta$ ~6000  $\Delta$ , preferably, in a range of 2000  $\Delta$ ~5000  $\Delta$ , can be used effectively. When the wavelength used is below the above-mentioned range, decomposition of the polymer is likely to take place; on the other hand, when the wavelength exceeds the above-mentioned range, an adequate energy required for excitation of the sensitizer cannot be achieved.

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In general, application of light for 16 seconds to 1 minute at 400 W from a high-pressure mercury lamp is adequate. The longer the application period of the light and the greater the output of the light source, the greater the increase in the degree of crosslinking and the greater is the effect on prevention of oozing of adhesive and telescoping that can be achieved.

The above-mentioned method where mutual crosslinking is performed for pressure-sensitive adhesive or the pressure-sensitive adhesive and a polymer added at the edge face of the tape is entirely different from methods such as coating of the above-mentioned material onto the edge face of the tape or forming a tack-free layer by conventional methods. In other words, when crosslinking is performed, only a very thin region at the surface of the pressure-sensitive adhesive on the edge face of the tape is hardened, thus, the surface appearance of the tape remains unchanged, the finish is clean, and furthermore, the hardened layer is chemically bonded to the pressure-sensitive adhesive polymer; thus, removal of the film as a result of impact does not occur.

Currently, heat and radiation are used as energy for crosslinking of standard polymers, but these methods are not suitable for the above-mentioned purpose, and the reason why photo energy is desirable is explained below.

When thermal crosslinking is used, the crosslinking agent applied to the edge face of the tape does not remain at the edge face and the crosslinking agent undergoes diffusion and permeation, thus, when heat is applied, it is not possible to concentrate the energy at the surface alone and the heat is transmitted inside, and as a result, crosslinking of the pressure-sensitive adhesive on the inside takes place and the initial adhesion of the pressure-sensitive adhesive tape is reduced.

Meanwhile, when high energy radiation is used, crosslinking of the pressure-sensitive adhesive on the inside is promoted due to the high energy and high permeability; furthermore, the above-mentioned high energy is likely to reach the substrate and is likely to cause crosslinking of the substrate; furthermore, a significantly higher cost is required for radiation equipment safety and other safety features.

On the other hand, penetration of the energy is low when crosslinking is done by the application of light in the present invention; thus, the energy only reaches the surface area due to the low transmittance of light energy, thus, crosslinking of the pressure-sensitive adhesive at the edge face of the tape alone is achieved.

Furthermore, unlike the two methods mentioned above, the process requires only simple equipment, and the treatment can be applied at a low cost.

As explained in detail above, according to the present invention, it is possible to make the edge face tack-free without changing the surface appearance of the tape, and a continuous process using a simple method involving application of light can be applied and the effect can be achieved in a short time without manual labor; furthermore, the device used is simple, and the treatment can be done at a low cost.



Furthermore, only a very thin region at the surface of the pressure-sensitive adhesive on the edge face of the tape is formed into a cured layer by means of crosslinking; thus, peeling of a thin paper or peeling of a protective layer does not occur.

As a result, oozing of adhesive can be prevented until all the tape is used and at the same time, telescoping can be prevented.

In the following, the effect and importance of the present invention is explained further in specific terms with application examples but the present invention is not limited to these application examples.

#### Application Example 1

As typical examples of pressure-sensitive adhesive tapes, those listed below were selected.

A pressure-sensitive adhesive tape with a substrate made of polyvinyl chloride having a rubber-based polymer as a pressure-sensitive adhesive (Sample No. 1) and pressure-sensitive adhesive tape with the substrate made of paper having a rubber-based polymer as a pressure-sensitive adhesive (Sample No. 2).

1 wt% of toluene solution of 2-chloroanthraquinone was coated onto both edge faces of the above-mentioned rolled tapes (width of 19 mm and length of 20 m), and when 400 W mercury lamp was applied for 20 seconds from a distance of 10 cm, the tack on the edge face was completely dissipated, and adhesion was absent when paper, etc. was applied to the edge face.

#### Application Example 2

A non-woven fabric made of a glass fiber impregnated with a solution consisting of 2 g of

benzophenone, 5 g of tetraethylene glycol dimethacrylate and 100 g of toluene was brought into contact with the edge face of a rolled tape (width of 19 mm and length of 20 m) having a substrate made of a polyester and a pressure-sensitive adhesive comprising an acrylic base polymer so as to transfer the solution to the edge face, and when 400 W mercury lamp was applied for 15 seconds from a distance of 10 cm, the tack on the edge face was completely dissipated (Sample No. 3).

#### Application Example 3

A solution consisting of 2 g of parachlorobenzaldehyde, ethylene-vinyl acetate copolymer (vinyl acetate content 45%) and 100 g of toluene was coated onto the edge face of a rolled self-stick tape mainly comprising a mixture of a butyl rubber and polyethylene (width of 19 mm and length of 10 m), and when 400 W mercury lamp was applied for 20 seconds from a distance of 10 cm, the tack on the edge face was completely dissipated. (Sample No. 4)

50 rolls each of the above-mentioned Sample No. 1~Sample No. 4 were used and the tapes of each Application Example without the above-mentioned treatments were used as well as the tapes produced in the following Comparative Examples 1 and 2 and the three different tests explained below were performed after storing samples in an air-conditioned room kept at a temperature of 40°C for 2 months and the results obtained are shown in Table I below. For the above-mentioned treated tape samples, a separate test was performed for basic properties of tapes such as adhesion, and no problems were observed.

Test methods

A: Stacking test

10 rolls each of rolled tapes were stacked and packaged, then stored in the above-mentioned air-conditioned room kept at a temperature of 40°C for 2 months. Defective in this case means tapes that stuck to one another and removal was difficult.

B: Paper peel test

A thin paper was applied to both edge faces of the samples and the samples were stored in the above-mentioned air-conditioned room kept at a temperature of 40°C for 2 months. Defective in this case means tapes where the pressure-sensitive adhesive on the edge face stuck on the thin paper and it was difficult to remove the paper.

C: telescoping phenomenon test

Each rolled tape was stored individually in the above-mentioned air-conditioned room kept at a temperature of 40°C for 2 months. Defective in this case means tapes where the protrusion of the edge face exceeds 3 mm after storage.

Each of the test results obtained is shown in Table I below.

Table I

Effect on prevention of oozing of adhesive and telescoping  
in pressure-sensitive adhesive tapes or self-stick tapes  
as a result of different treatment methods

| Sample           |   | No. 1 |      | No. 1 |      | No. 1 |      | No. 1 |      | Comp<br>Ex 1   | Comp Ex<br>2     |
|------------------|---|-------|------|-------|------|-------|------|-------|------|----------------|------------------|
| Treatment method |   | N-T   | L-Ap | N-T   | L-Ap | N-T   | L-Ap | N-T   | L-Ap | Coated<br>film | Paper<br>applied |
| Test             | A | 48    | 0    | 47    | 0    | 46    | 0    | 28    | 0    | 29             | 0                |
|                  | B | 50    | 0    | 50    | 2    | 46    | 0    | 48    | 0    | 38             | 4                |
|                  | C | 37    | 3    | 2     | 0    | 20    | 1    | 7     | 0    | 25             | 20               |

N-T = Non-treated

L-Ap = Light Application Treatment

In this case,

- (i) The numbers in the table are the number of samples regarded as defective due to oozing of adhesive and telescoping among 50 samples.
- (ii) Each sample was stored in an air-conditioned room kept at a temperature of 40°C for 2 months.
- (iii) Non-treated means outside the present invention.

#### Comparative Example 1

20 wt% methanol-water (50:50) solution of vinyl chloride- vinyl acetate copolymer (vinyl acetate content 30%) was coated onto both edge faces of the pressure-sensitive adhesive tape having a polyvinyl chloride substrate used for Sample No. 1 and drying was performed at a temperature of 80°C for 5 minutes. Slight tackiness was observed after drying.

**Comparative Example 2**

A polyvinyl chloride film with a thickness of 50  $\mu\text{m}$  and having the same shape and size as the edge face of the pressure-sensitive adhesive tape was applied to both edge faces of the rolled tape having the polyvinyl chloride substrate of Sample No. 1.

**Claims of the invention**

- 1 A rolled tape produced by dispersing an organic solution containing a crosslinkable photosensitizer onto an edge face with adhesion of a rolled pressure-sensitive adhesive tape or self-stick tape and exposing the edge face to light.
- 2 A rolled tape produced by dispersing an organic solution containing a crosslinkable photosensitizer and photoactive crosslinking agent onto the edge face with adhesion of a rolled pressure-sensitive adhesive tape or self-stick tape and exposing the edge face to light.
- 3 A rolled tape produced by dispersing an organic solution containing a crosslinkable photosensitizer and vinyl-based tack-free, and an optional photoactive crosslinking agent onto the edge face with adhesion of a rolled pressure-sensitive adhesive tape or self-stick tape and exposing the edge face to light.